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# NEUROLOGICAL MATURATION IN THE FIRST SEMESTER OF LIFE IN SMALL FOR GESTATIONAL AGE INFANTS

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ABSTRACT - Our aim was to evaluate the acquisition of neuropsychomotor development marks in small for gestational age infants during the first six months of life. A non-controlled cross-section study with thirty full-term newborn small for gestational age infants was performed in a University Hospital in the Southern region of Brazil. These infants were followed up during six months and compared with literature data regarding adequate to gestational age newborn babies. Anthropometric data, epidemiologic characteristics, neurological exam and neuropsychomotor evolution were analyzed. There were significant variations in the acquisition of abilities, as the cephalic support at 3 months of age and delay in lalation. In other aspects, babies born small for gestational age evoluted in a similar way as newborn ones standards. It is suggested that case control studies are performed aiming at deepening the analysis of these studies.

KEY WORDS: retard/restriction of intra-uterine growth, neurological evolution, intra-uterine malnutrition.

**Maturação neurológica no primeiro semestre de vida em crianças pequenas para a idade gestacional**

RESUMO - Nosso objetivo foi avaliar a aquisição de marcos do desenvolvimento neuropsicomotor em crianças nascidas pequenas para a idade gestacional, durante o primeiro semestre de vida. Foi realizado um estudo de coorte não controlada, com 30 recém-nascidos pequenos para a idade gestacional provenientes de um hospital universitário na região sul do Brasil, acompanhados durante seis meses e comparados com dados de literatura a respeito de recém-nascidos adequados para a idade gestacional. Foram analisados dados antropométricos, características epidemiológicas e a evolução do exame neurológico e do desenvolvimento neuropsicomotor. Houve variações significativas na aquisição de habilidades como o sustento cefálico aos 3 meses e atraso na lalação. Nos demais aspectos os bebês nascidos pequenos para a idade gestacional evoluíram de forma semelhante aos padrões de lactentes normais. Sugere-se que estudos caso-controle sejam realizados com a finalidade de aprofundar a análise desses resultados.

PALAVRAS-CHAVE: retardo/restrição de crescimento intra-uterino, evolução neurológica, desnutrição intra-uterina.

To evaluate neurological maturation, it is necessary to know normality and its possible variations[1-3]. This work is based on the observation of newborn development standards who presented as specific characteristic at their birth weight below 10 per cent of the normal curve for gestational age[4].

The adequate neurological maturation is an integrity indicator of the nervous central system. According to Jackson, during the neurological evolution the infant replaces progressively his most primitive functional systems by more elaborate ones, in a hierarchy where complex functions inhibit elementary ones[5]. The knowledge of neurodevelopment normality and the dynamic nature of neurological maturation instrumentalize the health team with important data regarding evolution and prognosis[1,2]. The observation of the neuropsychomotor development is a valuable tool to detect and prevent the establishment of abnormal standards of evolution[6-10].

Authors from the 70's to the 90's identified higher morbidity and mortality rates in the small for gestational age newborn group (SGA), and they attempted to recognize anthropometric, maturation and development standards in these infants[6-11]. Mc Cormick

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and Strauss, in excellent review works, reported studies about newborns SGA (NB), trying to establish common standards and comparable aspects among them[12,13]. The best way of studying this population is far from a consensus. Current studies about SGA children have moved away potentials as prematureness, anoxia and evident genetic alterations and chronic infection diseases during pregnancy in an attempt to characterize the intra-uterine malnutrition repercussion[14-15]. The comparison of results is difficult and many times unproductive due to methodology differences, follow-up difficulties, geographical diversity and different evaluation systems of patients' performance[16]. In industrialized countries there is a great number of studies about SGA NB, some with population samples quite representative, but with difficult correlation data[13,17,18]. In developing countries the incidence of SGA born is bigger in low socio-economic classes, who present higher exposition risk to factors that predispose retard of intra-uterine growth (RIUG)[6]. Although there is a good number of Brazilian studies about intra-uterine malnutrition, the experimentation as to SGA NB development is still small in our environment[19-22]. The importance of follow-up work is evident due to the role of regional variations in the RIUG heterogeneity[16].

This research aimed at evaluating children's development diagnosed with SGA at birth, comparing their neurdogical exam (NE) with standardizations of the newborn normal neurological exam[1-3] in order to verify the existence of characteristic aspects in their development during their first semester of life.

## METHOD

A non-controlled cross-section study was performed comparing SGA NB with literature data about adequate to gestational age (AGA) newborns[2-3]. The clinical conclusion was the presence or absence of differences in acquisition speed of neurological development marks during the first semester of life. All SGA evaluated came from Hospital Geral de Caxias do Sul in sequence births occurred in the period from September 2001 to August 2002 and followed during their first semester of life. Hygid NB, living in Caxias do Sul, with birth weight below ten per cent of Battaglia and Lubcchenco's curve[4], having >37-week gestational age through Capurro's method[23] were included. The cases that presented neurological pathology during the neonatal period, identified genetic diseases during *follow-up,* as well as the NB whose responsible parent did not sign the informed permission term were excluded. All newborns were evaluated by the same examiner.

The initial evaluation consisted of an interview with the mother in order to collect the obstetric history and epidemiological data. Then, the NE was performed in a separate room where the NB babies were placed together and in the incubator or cradle for the hospitalized ones. The steps III an IV of the sleep-wake cycle were respected, according to Prechtl's criteria[24]. The NE[1,3] was performed between 48 and 72 hours of life, avoiding the birth's shocking period[25] in order to determine the pediatric gestational age and neuronal maturation. The *follow-up* consisted of revisions in the 3rd and 6th months of life, with anthropometric evaluation and NE[1,2].

The study was submitted to evaluation to the Medical Ethics Committee of Hospital Geral and to the Ethics Counsel of Centro de Ciências Biológicas e da Saúde - Universidade de Caxias do Sul, being considered of minimum risk and obtaining approval for its performance.

## RESULTS

Thirty SGA NB met the selection criteria for this study and the responsible parent agreed with their participation. Twenty-six three-month-old babies (86.66%) and twenty-five six-month-old babies (83.33%) returned to the consultation. The sampling was composed of 70.00% female newborns and 73.33% of the children were white. Two twin pregnancies, both with female babies, were included in the group.

Out of 28 mothers interviewed, 22 reported to have gotten pregnant without planning (78.57%). The pregnancy was described as well accepted in 20 cases (71.42%) and difficult in 8 cases (28.57%). Seven mothers admitted to be smokers (25.00%), consuming 5 to 30 cigarettes a day, with an average of 17.6 cigarettes/day. Three mothers (10.71%) related to use alcohol once to week during the first months and one (3.57%) at time smoked marijuana.

The mothers' age varied from 15 to 40 years old, with an average of 24.6 years old. Seven mothers (25.00%) were younger than 20 years old and 3 (10.71%) were older than 34 years old. In the group studied there was a predominance of white mothers and fathers, 64.28% and 57.14%, respectively. The fathers' age varied from 18 to 42 years old, with an average of 27.8 years old. Eight mothers (28.57%)

*Table 1. Anthropometric data of newborns.*

| NB=30 | Mean (±SD) | Minimum | Maximum |
|---|---|---|---|
| Weight (g) | 2286.33 (±196.97) | 1835 | 2585 |
| Length (cm) | 45.18 (±1.61) | 42 | 48 |
| HC (cm) | 32.78 (±1.10) | 30 | 35 |
| CC (cm) | 30.12 (±1.42) | 27 | 33 |
| AD (cm) | 19.45 (±1.33) | 16.5 | 22 |
| BD (cm) | 18.13 (±1.00) | 16 | 21 |

SD, standard deviation; BW, birth weight; HC, head circunference; CC, chest circumference; AD, anteroposterior distances; BD, bi-auricular distances; g, gram; cm, centimeters.

*Table 2. Neonatal intercurrences.*

| Characteristics | Frequency | % |
|---|---|---|
| Without intercurrences | 20 | 66.66 |
| With intercurrences | 10 | 33.33 |
| Hypoglycemia | 6 | 20.00 |
| Hyperglycemia | 2 | 6.66 |
| Jaundice | 2 | 6.66 |
| Early respiratory malfunction | 2 | 6.66 |
| Convulsions | 1 | 3.33 |
| Sepsis | 1 | 3.33 |
| Polycitemia | 1 | 3.33 |

Some NB presented more than one intercurrence.

declared to be married, eleven (39.28%) lived together with a partner, eight (28.57%) declared to be single and one divorced (3.57%).

The pre-natal follow-up was performed at Health Centers in 92.85%. Seven patients (25.00%) were included in high risk assistance, one of them with twin pregnancy. The number of consultations varied from 1 to 12. Eight patients (28.57%) had less than 4 consultations during pregnancy. Ten mothers were pregnant for the first time (35.71%) and 18 were multiparous mothers (64.28%). Four mothers having their second baby (14.28%) had spontaneous abortion in their previous pregnancy. There was no report of spontaneous abortion in mothers with three or more months pregnant in the group studied. The NB anthropometric data are shown in Table 1.

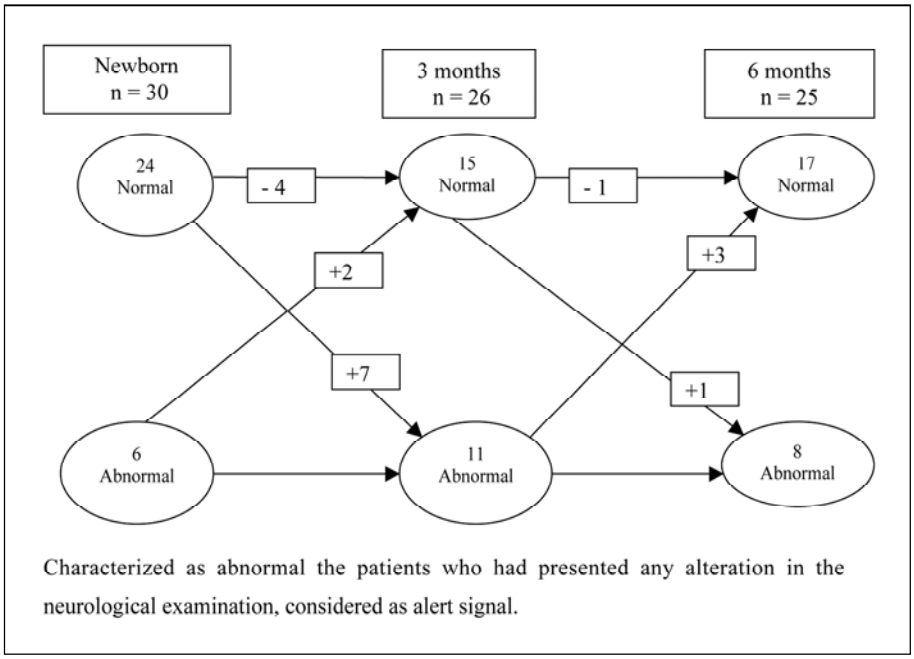
Ten children needed to be hospitalized, hypoglycemia being the most common intercurrence, asymptomatic in three patients, with shaking in two and a convulsion crisis in one. The intercurrences are shown in Table 2.

Alterations in the neurological exam in six children were identified (20.00%). One of them presented hypotony. The five hypertonic NB also presented hyperreflexia (16.66%); out of these, one presented left hemiparesia (3.33%) without definitive etiology and another periphery facial paralysis for tocotraumatism on the right side with symmetric apendicular force (3.33%).

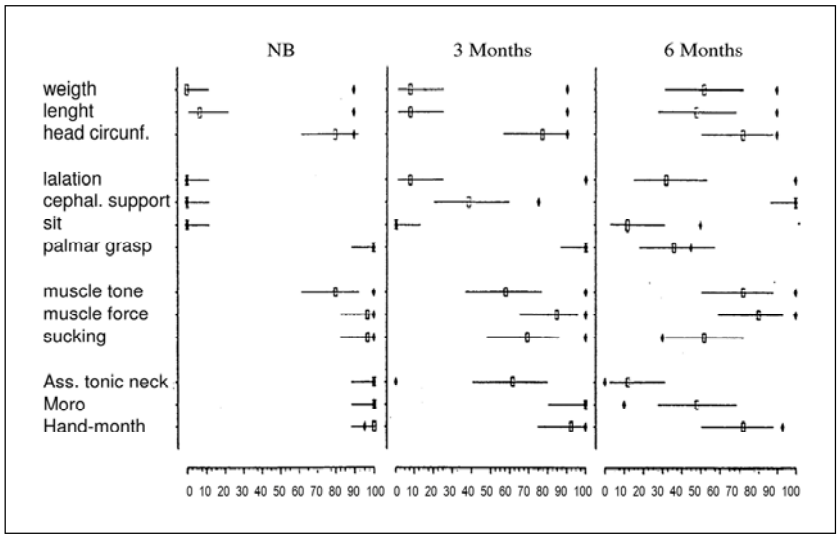
Trophism was diminished in 26 children (86.66%). All eutrophic-like babies presented their first neurological exam normal, although two of them needed to be hospitalized due to intercurrences related to intra-uterine malnutrition.

In the following-up, the complete neurological evaluation was considered, with data about their neuromotor evolution (tonus, strength, reflexes, coordination and balance) and due acquisitions of the age group (neurodevelopment marks).

Out of the 26 babies who returned at three months old, 15 babies (57.69%) presented neurological exam compatible with normality and 11 (42.30%) demonstrated in their neurological evaluation higher or lower alert signs. Any standard deviation from normality was considered as an alert sign, respecting the normal variables of each period. Parents of children




*Graph 1. Neurological exam: normal x abnormal.*




*Graph 2. Neurological development marks and anthropometric dates at birth, 3 and 6 months of age. Evolution of the studied group's neurologic development in comparison with Diament's results[2].*

who presented alert signs were orientated to perform home stimulation and posture adequation. The evaluation was repeated within two weeks and the exam was normal in two babies (7.69%).

At three months of age, out of the six babies with neurological exam altered in the neonatal period, only four (15.4%) kept evidences of neurological exposure and seven babies (26.92%) who had previous normal NE presented alterations. At six months of age, 17 babies (68.00%) presented normal neurological exams against 8 (32.00%) altered. The neurological exam during the neonatal period could predict 13 normal babies (52.00%) and allowed that four babies (16.66%) with neurological alterations at six moths of age were diagnosed and followed since their birth. The results of follow-up are shown in Graph 1.

The results were compared with the development marks established by Diament[2], according Graph 2.

## DISCUSSION

By comparing the results obtained in this study with those of the literature, some aspects appear more evident. The group studied presented few alterations in the neurological exam in the neonatal period when compared with a similar research done by Gherpelli et al.[20]. In the referred study, there was a percentage of neurological abnormalities in 51.35% of the newborns, being hypotony and hyperexcitability the most prevalent ones, fact not observed in this sampling. The difference of results may be related to the presence of children with neonatal asphyxia and the prematureness in the sampling of the mentioned authors, variables that can interfere in the neurological performance[14,15]. In that study, there was also a great number of false positives with reduction of altered NE of 33.33% at six months and 32.43% in the end of their first year of life[20]. In the present study, the number of false negatives was bigger, suggesting that among SGA infants without major complications, small alert signs may be imperceptible during their first months of life, what shows the importance of an active search with periodic neurological revisions.

It is observed a discrete difference in the acquisition of cephalic support in SGA in relation with Diament's normal newborn group[2] at three months of age and a retard in lalation at three and six months of age. In the ability to sit without support, around six months, there was a non significant retardin the SGA group. This can correspond to regional variations once in the area where the study was performed, it is not common for a baby to play on the floor due to the cold weather.

In the primitive reflex research, the SGA group kept fragments of asymmetric tonic-cervical reflexes for longer time than that usually described in the literature[1-3]. Moro's reflex was present for longer time, similar to the evolution of premature born babies[26], and the hand-mouth reflex was present according to Pedroso's findings in normal babies[27].

Achenbach et al. cited several intervention works performed in families having low weight babies (LW) - full term SGA and PMT, SGA or AGA - aiming at improving care and stimulation conditions in these children, especially in low socio-economic classes[9]. The authors observed that at 6 and 12 months of age the LW groups stimulated (SLW) and LW not stimulated (NSLW) did not differ among them and were significantly below the development standards in

relation to the normal weight group. At 2 years old, the stimulated low weight group started to become different from the non-stimulated low weight group, obtaining better scores in Bayley's scale *(Bayley Mental Developmental Index),* even without statistically significant alterations. This difference became progressively more stressed at 3 and 4 years of age. The test performance at 7 years of age was significantly better in the stimulated low weight group. Between 3 and 7 years of age, the authors found equivalent development and anthropometric standards among normal weight born babies and stimulated low weight ones. In the non- stimulated low weight control group the results were lower. They conclude that early stimulation has a cumulative effect over development and overcoming of biological risks, what is in accordance with the present study.

Drillien compared monozygotic twin boys and found lower intellectual quotient (IQ) in low weight twin babies[6]. He also observed that the comparison between full term and pre-term babies, both having normal weight and malnutrition, did not show differences regarding the IQ evolution in babies raised in favorable socio-economic conditions. Yet, in babies raised in low socio-economic families, malnutrition and prematureness were related to lower performance in IQ evaluations[6]. It is known that, in unfavorable social conditions, small alterations in children's development can be more expressive than in high income populations[28].

From these observations, a question is put in this study: we may be directing investigations about SGA children performance under an incomplete approach. Perhaps RCIU repercussion in the child's development is lower than the influence of other factors that can follow this condition, keeping an unfavorable evolution standard. It is coherent to think that the influence of these factors is intimately related to the results obtained in SGA baby's analysis, with difficulty of dissociation among these variables.

The small number of children studied may make it difficult the reproduction of this study in other regions. We know that a higher number of cases could increase the results reliability. However, selecting and following SGA babies born without any other intercurrences that interfere in the SNC development is difficult, a fact that was corroborated by Gherpelli et al. results, who were able to follow 37 SGA babies in a bigger center, without excluding all neonatal interfering factors[20].

This research intends to focus on a further broader study, with a bigger number of SGA NB and with at least a 12 month follow-up, for the normality curve of these children seems to have special characteristics. These characteristics need to be considered when we make a prognosis of a baby's evolution based on neurological evaluations of the first year of life. Respecting the influence of other variables in these babies' development, the intra-uterine malnutrition demonstrates an alert sign that must be strongly considered in the early follow-up evaluation. Results of these children's group are very similar to normal development in communities where stimulation requirement is the rule[18]. However, neuropsychological evolution and academic conditions of SGA born children are far from the normality curve in most works. This probably indicates some difficulty to identify the early alert signs, which would allow us to interfere in these babies' evolution.

In terms of public health, we can suggest that the neurological follow-up with early stimulation intercurrence could change the future of these individuals. It is suggested that control-case studies are be performed aiming at deepening the analysis of these results.

Follow-up programs directed toward this population can improve their perspectives. By understanding the actual causes of development alterations in SGA, we will be able to fight against them more incisively, allowing early posture intervention and adequate stimulation, considering the group and the individual needs.

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